CLAIMS

What is claimed is:

1. A device for calibrating an aberroscope comprising an optical element insertable into an optical path of a wavefront analyzer, the optical element adapted to induce a predetermined aberration in a wavefront for presentation to the wavefront analyzer.

2. The device recited in Claim 1, wherein the optical element comprises a hologram.

3. The device recited in Claim 2, wherein the hologram comprises a substrate having a surface imposed thereon adapted to reproduce a desired optical wavefront, the desired optical wavefront having the predetermined aberration.

4. The device recited in Claim 3, wherein the desired aberrated wavefront comprises a wavefront modeled using Zernike polynomials.

5. The device recited in Claim 2, wherein the hologram comprises a computer-generated hologram.

6. The device recited in Claim 2, wherein the hologram is insertable into an optical path of a Hartmann-Shack wavefront analyzer.

7. The device recited in Claim 1, wherein the optical element comprises a lens optimized for a specific power and aberration.

8. The device recited in Claim 7, wherein the lens comprises a plurality of lenses operating in concert to induce the predetermined aberration.

9. The device recited in Claim 1, wherein the optical element comprises a spatial light modulator adapted to induce the predetermined aberration.

10. The device recited in Claim 1, wherein the optical element comprises means for inducing a predetermined amount of defocus in the wavefront, the defocus amount serving to shift a wavefront analyzer range of measurement from a first range between a first minimum value and a first maximum value to a second range between a second minimum value and a second maximum value, the first and the second minimum value and the first and the second maximum value differing by the predetermined amount of defocus.

11. The device recited in Claim 1, wherein the optical element is selected from a group consisting of a reflective and a transmissive optical element.

12. A system for calibrating an aberroscope, comprising:

a wavefront analyzer comprising a wavefront detector at a downstream end of an optical path; and

An optical element insertable into an optical path of the wavefront analyzer, the optical element adapted to induce a predetermined aberration in a wavefront for presentation to the analyzer.

13. The system recited in Claim 12, further comprising means for collimating an incoming wavefront onto the detector downstream of the optical element.

14. The system recited in Claim 12, wherein the optical element is selected from a group consisting of a reflective and a transmissive optical element.

15. The system recited in Claim 12, wherein the optical element comprises a hologram.

16. The system recited in Claim 15, wherein the hologram comprises a computer-generated hologram.

17. The system recited in Claim 12, wherein the wavefront analyzer comprises a Hartman-Sack wavefront analyzer.

18. The system recited in Claim 17, wherein the Hartmann-Shack wavefront analyzer comprises:

an entrance pupil for admitting the incoming wavefront;

a first afocal optical system for forming an image of the entrance pupil onto an intermediate pupil plane;

a lenslet array; and

a second afocal optical system for forming an image of the intermediate pupil plane onto the lenslet array, the lenslet array for sampling the intermediate pupil image onto the wavefront detector; and wherein:

the optical element is positioned at a location selected from a group consisting of adjacent the entrance pupil, at the intermediate pupil plane, and adjacent a plane of the lenslet array.

19. The system recited in Claim 18, further comprising a beamsplitter, and wherein:

the optical element comprises a reflective computer-generated hologram;

the first afocal optical system comprises a first converging lens and a first collimating lens, the first collimating lens positioned to receive the incoming wavefront from the first converging lens at a first face and to output a collimated wavefront from a second face, the first converging lens and the first collimating lens together operating to image the entrance pupil onto the intermediate pupil plane, the computer-generated hologram positioned to receive and reflect the collimated wavefront onto the first collimating lens, the

beamsplitter positioned and adapted to permit the incoming wavefront exiting the first converging lens to pass through substantially unaltered;

the second afocal optical system comprises a second converging lens, the second converging lens comprising the first collimating lens positioned to receive a reflected wavefront from the hologram at the second face and to output a converging wavefront from the first face onto the beamsplitter; and

the second afocal optical system further comprises a second collimating lens positioned to receive the converging wavefront from the beamsplitter and to output a second collimated wavefront onto the lenslet array.

20. A method for calibrating an aberroscope comprising the steps of:

passing an unaberrated wavefront along an optical path leading to a wavefront analyzer;

inducing a predetermined aberration in the unaberrated wavefront to form an aberrated wavefront using an optical element positioned in the optical path upstream of a wavefront analyzer;

analyzing the aberrated wavefront exiting the optical element using the wavefront analyzer; and

calibrating the wavefront analyzer using data generated by the wavefront analyzer from the aberrated wavefront.

21. The method recited in Claim 20, wherein the inducing step comprises shifting a wavefront analyzer range of measurement from a first range between a first minimum value and a first maximum value to a second range between a second minimum value and a second maximum value, the first and the second minimum value and the first and the second maximum value differing by an amount determined by the optical element.

22. The method recited in Claim 20, further comprising the step of collimating the aberrated wavefront onto the wavefront analyzer downstream of the optical element.

23. The method recited in Claim 20, further comprising the steps of:

admitting the unaberrated wavefront into an entrance pupil;

using a first afocal optical system to form an image of the entrance pupil onto an intermediate pupil plane;

using a second afocal optical system to form an image of the intermediate pupil plane onto a lenslet array of the wavefront analyzer; and

sampling the intermediate pupil plane image at the lenslet array and presenting the image samples onto the wavefront analyzer; and wherein:

the aberration inducing step comprises positioning the optical element at a location selected from a group consisting of adjacent the entrance pupil, at the intermediate pupil plane, and adjacent a plane of the lenslet array.

24. The method recited in Claim 23, wherein:

the optical element comprises a reflective computer-generated hologram;

the first afocal optical system comprises a first converging lens and a first collimating lens, wherein the first collimated lens is positioned to receive a first wavefront from the first converging lens at a first face and to output a collimated, unaberrated wavefront from a second face; and

the inducing a predetermined aberration step comprises;

receiving the collimated, unaberrated wavefront at the hologram;

inducing the predetermined aberration in the collimated, unaberrated wavefront to produce an aberrated wavefront; and

reflecting the aberrated wavefront onto the first collimating lens; and

further comprising the steps of;

converging the aberrated wavefront by passing through the second face and out of the first face of the first collimating lens; and

reflecting the converged, aberrated wavefront onto a second collimating lens to output a collimated, aberrated wavefront onto the lenslet array.

25. The method recited in Claim 20, wherein the optical element comprises means for inducing a predetermined amount of defocus in the unaberrated wavefront, the defocus amount serving to shift a wavefront analyzer range of measurement from a first range between a first minimum value and a first maximum value to a second range between a second minimum value and a second maximum value, the first and the second minimum value and the first and the second maximum value differing by the predetermined amount of defocus.

26. A method of constructing a device for calibrating an aberroscope comprising the steps of:

determining a desired aberration;

creating a hologram having the desired aberration; and

positioning the hologram upstream of a wavefront analyzer.

27. The method recited in Claim 26, wherein the determining step comprises modeling a wavefront having the desired aberration using Zernike polynomials.

28. The method recited in Claim 26, wherein the determining and creating steps comprise using a computer to calculate the desired aberration and to create the hologram on a substrate.

29. The method recited in Claim 26, wherein the hologram comprises one of a transmissive and a reflective computer-generated hologram.